

## Morpheus AUV Development

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### LONG-TERM GOAL

The long-term goal of this project is to develop an effective field-reconfigurable non-metallic AUV platform for use in littoral ocean sampling and to benefit broader Navy goals related to improved Mine Counter Measures. Accomplishing this goal requires additional effort in the “hardening” and refinement of the existing Morpheus AUV for fleet operations. Reliable reconfigurable AUV platforms with extended capabilities and sensing options are the building blocks of proposed multi-vehicle cooperative REA and MCM missions that will eventually remove navy divers from life threatening situations.



*Figure 1. Morpheus AUV on Cart and aboard RHIB at KB01 exercise*

### OBJECTIVES

This project was to improve the operational readiness and robustness of the Morpheus AUV system, leading to the performance of field demonstrations of various advanced technologies. These experiments and exercises will provide information evaluation and risk mitigation associated with procurement decisions that are critical to the successful incorporation of AUV technology into fleet operations. The specific objectives of this project included: (1) Utilization of ONR rights to transfer the Morpheus technology from the academic environment to a commercial entity; (2) Improve the

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documentation, configuration control environment, operational readiness and robustness of the Morpheus AUV; (3) Complete the design of the Morpheus AUV, correct design deficiencies, and add functionality to the system; (4) Operate the Morpheus AUV system in various fleet related technology demonstrations and exercises.

## **APPROACH**

Using available statistics associated with Morpheus reliability, as well as operational experience, various aspects of the system were selected for additional design or evaluation efforts. These efforts were to be performed in a commercial environment with emphasis on enhanced function and reliability yielding improved system availability for demonstration purposes.

Utilizing ONR rights defined by the terms and condition associated with grants to academic institutions, the technical data associated with the Morpheus AUV was to be transferred to SeaRobotics and utilized to fulfill this contract. Through an aggressive design and operational pace, Morpheus would rapidly progress toward an acceptable operational state. Morpheus usage at KB01 allowed operational evaluation of the state of the Morpheus system.

Additional functionality was to be added to Morpheus after minimum initial operational capability was reached.

The data transfer defining the Morpheus technology was begun after authorization by appropriate ONR and FAU representatives, however, the data was never utilized due to legal disputes initiated by FAU.

A list of problems and areas for potential enhancement to Morpheus was created as a result of preparing the AUV for KB01 and conducting exercises at KB01 [1]. The areas that did not require access to the disputed Government Furnished Information (GFI) were investigated and solutions to correct the deficiencies or enhance the system were developed.

## **WORK COMPLETED**

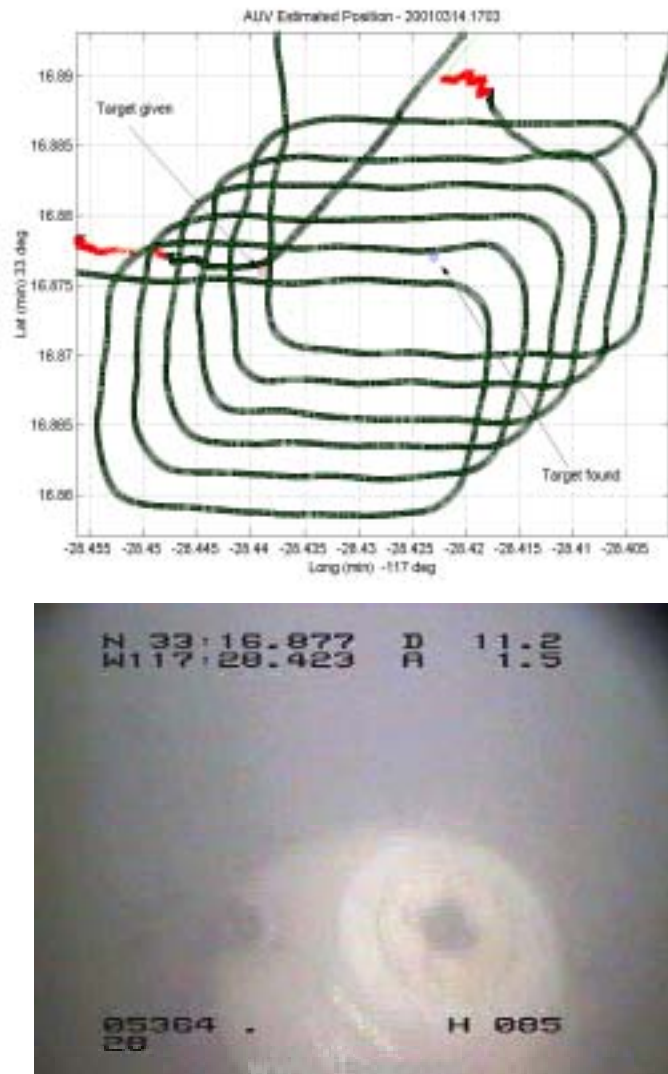
All preparations have been made to provide the required infrastructure to accept and perfect the Morpheus technical specifications and software. Additionally, a series of investigations were carried out to identify and solve some of the Morpheus problems and deficiencies evidenced during recent operations and exercises (related to KB01). These investigations covered the topics of Graphical User Interface (GUI), Battery System, RF Modem, CTD Comparison, DVL Investigation, DGPS System, Trim and Balance, and Tracking beacons.

The Morpheus and OEX AUVs were prepared for operations at the KB01 fleet exercise and operations were carried out with the Morpheus system.

## **RESULTS**

*KB01 Exercise:* Morpheus was successful in demonstrating target Reacquisition and Identification (RI) using an ambient light video system. Due to poor visibility (1-1.5 meters), the missions were conducted with Morpheus operating at a constant altitude of 1.5 meters. Acoustic modem target redirection was also demonstrated and shown to be very useful. After completing repairs due to component failures, Morpheus' missions were run successfully and two of the three targets of interest

were reacquired and identified. One was identified as a Manta and the other as a VEMS target. Figure 2. depicts the RI mission track plot from the vehicle data and the video image of the Manta mine.



**Figure 2. Morpheus AUV track plot and video image of Manta mine**

*Morpheus added functionality and deficiency solutions:* A series of investigations was carried out to identify and solve some of the Morpheus problems and deficiencies evidenced during operations and exercises related to KB01. These investigations resulted in a top level design of a Graphical User Interface (GUI) and Battery System as well as providing solutions to problems relating to the RF Modem [2,3,4], DGPS System, Trim and Balance for multiple Morpheus configurations, and the elimination of a backup tracking beacon.

## **IMPACT/APPLICATIONS**

The ultra modular plastic two man portable Morpheus AUV technology will significantly add to the Navy capability to conduct MCM operations in coastal areas. It should also become a basic component

of multi-AUV cooperation and communications [5] due to its multi-configurable and multi-purpose AUV capability.

## **TRANSITIONS**

This AUV technology should be utilized to conduct advanced technology field demonstrations leading to the evaluation and future development of subsystems such as small synthetic aperture sonars, gradiometers [6], various forward looking and imaging sonars, and small low cost navigation systems. Flexibility and field reconfigurability will make Morpheus a valuable evaluation tool and operational asset.

## **RELATED PROJECTS**

1. Accelerated Integration of the Autonomous Underwater Small Synthetic Aperture Minehunter (SSAM) into the Morpheus Vehicle
2. Magnetic Sensing for VSW Mine Reconnaissance. Use of a Room Temperature Gradiometer (RTG) on AUV for detection, localization, and classification of mines in VSW.

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